

CLAIMS

1. An intake port for an internal combustion engine having at least one cylinder, a piston mounted for reciprocating movement in the cylinder, said reciprocating piston in said cylinder defining a swept cylinder displacement, a cylinder head having one or more intake valves in fluid communication with said intake port, an intake valve seat for each of said one or more intake valves, each intake valve seat having an intake valve seat inner diameter for sealing contact with said valve, each of said valve seat inner diameters further having an inner valve seat cross section area, and an intake plenum,

said intake port for an internal combustion engine having an inlet end and an outlet end, said inlet end being in fluid communication with said plenum and said outlet end being in fluid communication with said intake valve for flow of intake air or another fluid from said plenum through said intake port into said cylinder,

wherein said intake port has a total outlet area, said total outlet area being equal to the sum of the inner valve seat cross section areas for the one or more intake valves in fluid communication with said intake port, and said intake port has an equivalent outlet diameter, said equivalent outlet diameter being equal to the square root of the quantity total outlet area times four divided by pi,

wherein said cylinder head has two intake valves in fluid communication with said intake port,

wherein said intake port includes a ram tuning pipe, a venturi having a throat and a venturi cross section area, said venturi cross section area being measured at said throat, a surge chamber, an outlet nozzle,

wherein the intake port has a ratio of venturi cross section area to total outlet area, said ratio of venturi cross section area to total outlet area being no more than 0.87,

wherein the intake port has a tuning length, said tuning length being the average distance between the throat and the one or more intake valve seat inner diameters,

wherein said surge chamber has a surge chamber inlet end and a surge chamber outlet end, said surge chamber inlet end being located 30 percent of the tuning length downstream of said throat, and said surge chamber outlet being located 20 percent of the tuning length upstream of said intake valve inner seat diameter, said surge chamber

further having a volume within said intake port and between said surge chamber inlet end and said surge chamber outlet end,

wherein the surge chamber volume is greater than the product of total outlet area times 0.26 times the tuning length,

wherein said venturi has a venturi inlet end and a venturi outlet end, said venturi inlet end being located 5 percent of the tuning length upstream of said throat, and said venturi outlet being located 5 percent of the tuning length downstream of said throat, said venturi further having a venturi volume within said intake port and between said venturi inlet end and said venturi outlet end,

wherein the venturi volume is less than the product of total outlet area times 0.09 times the tuning length,

thereby providing an intake port with a high flow coefficient and dynamic tuning for a high volumetric efficiency.

2. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein the intake port has a tuning length greater than 115 millimeters,

thereby providing a long tuning length and a large surge chamber.

3. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein the intake port has a ratio of tuning length to the equivalent outlet diameter, said ratio of tuning length to equivalent outlet diameter being at least 2.4,

thereby providing a long tuning length and a large surge chamber.

4. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein the intake port has a ratio of surge chamber volume to venturi volume, said ratio of surge chamber volume to venturi volume being at least 4.6,

thereby providing a large surge chamber.

5. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein the intake port has a ratio of surge chamber volume to venturi volume, said ratio of surge chamber volume to venturi volume being no more than 8.0,

thereby providing a streamline port shape.

6. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein the intake port has an overall port length, said overall port length being the average distance between the plenum and the one or more intake valve seat diameters, wherein the intake port has a ratio of tuning length to overall port length, said ratio of tuning length to overall port length being at least 0.325, thereby providing a long tuning length and a large surge chamber.

7. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein said intake port has a ratio of venturi cross section area to cylinder displacement, said ratio of venturi cross section area to cylinder displacement being no more than 0.0022 square millimeters of venturi cross section area per cubic millimeter of cylinder displacement, thereby providing a small venturi nozzle cross-section area and high-speed inlet flow for high power output from the engine.

8. The intake port for an internal combustion engine having at least one cylinder of claim 1, further including a fuel injector having a fuel injector tip, and an injector tip port section in said intake port having a injector tip port cross section area, said injector tip port cross section area being greater than the sum of 0.75 times said venturi cross section area plus 0.25 times said total outlet area, thereby providing a large degree of diffusion upstream of the injector tip.

9. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein the intake port has a tuning length greater than 115 millimeters, wherein the intake port has a ratio of surge chamber volume to venturi volume, said ratio of surge chamber volume to venturi volume being at least 4.6, wherein said intake port has a ratio of venturi cross section area to cylinder displacement, said ratio of venturi cross section area to cylinder displacement being no

more than 0.0022 square millimeters of venturi cross section area per cubic millimeter of cylinder displacement,

thereby providing a large surge chamber and a small venturi nozzle cross-section area for high-speed flow and a high power output from the engine.

10. The intake port for an internal combustion engine having at least one cylinder of claim 1, wherein the intake port has a ratio of venturi cross section area to total outlet area, said ratio of venturi cross section area to total outlet area being no more than 0.68,

wherein the surge chamber volume is greater than the product of total outlet area times 0.31 times the tuning length,

wherein the venturi volume is less than the product of total outlet area times 0.08 times the tuning length,

wherein the intake port has a ratio of surge chamber volume to venturi volume, said ratio of surge chamber volume to venturi volume being at least 5.3,

thereby providing a large surge chamber and a small venturi volume for a high port flow velocity and a high volumetric efficiency.

11. The intake port for an internal combustion engine having at least one cylinder of claim 10, wherein said intake port has a ratio of venturi cross section area to cylinder displacement, said ratio of venturi cross section area to cylinder displacement being no more than 0.0021 square millimeters of venturi cross section area per cubic millimeter of cylinder displacement,

thereby providing a small venturi nozzle cross-section area and high-speed inlet flow for high power output from the engine.

12. The intake port for an internal combustion engine having at least one cylinder of claim 11, wherein the intake port has a tuning length greater than 135 millimeters,

thereby providing a long tuning length for an aerodynamic diffuser.

13. The intake port for an internal combustion engine having at least one cylinder of claim 12, further including a fuel injector having a fuel injector tip, and an injector tip port section in said intake port having a injector tip port cross section area,

said injector tip port cross section area being greater than the sum of 0.75 times said venturi cross section area plus 0.25 times said total outlet area,

wherein the intake port has a ratio of tuning length to the equivalent outlet diameter, said ratio of tuning length to equivalent outlet diameter being at least 3.1,

thereby providing a long tuning length and a large surge chamber, and a large degree of diffusion upstream of the injector tip.

14. The intake port for an internal combustion engine having at least one cylinder of claim 13, wherein the intake port has a tuning length greater than 145 millimeters,

thereby providing a long tuning length for an aerodynamic diffuser.

15. The intake port for an internal combustion engine having at least one cylinder of claim 11, wherein the intake port has a tuning length greater than 145 millimeters,

thereby providing a long tuning length for an aerodynamic diffuser.

16. The intake port for an internal combustion engine having at least one cylinder of claim 15, wherein the intake port has a ratio of venturi cross section area to total outlet area, said ratio of venturi cross section area to total outlet area being no more than 0.625,

thereby providing a small venturi cross-section area for very high-speed pulsating flow, and a long tuning length for an aerodynamic diffuser.

17. The intake port for an internal combustion engine having at least one cylinder of claim 16, further including a fuel injector having a fuel injector tip, and an injector tip port section in said intake port having a injector tip port cross section area,

said injector tip port cross section area being greater than the sum of 0.75 times said venturi cross section area plus 0.25 times said total outlet area,

wherein the intake port has a ratio of surge chamber volume to venturi volume, said ratio of surge chamber volume to venturi volume being no more than 8.0,

wherein the intake port has a ratio of tuning length to overall port length, said ratio of tuning length to overall port length being at least 0.325,

wherein the intake port has a ratio of tuning length to the equivalent outlet diameter, said ratio of tuning length to equivalent outlet diameter being at least 3.1,

thereby providing a streamline intake port having a long tuning length and a large surge chamber.

18. The intake port for an internal combustion engine having at least one cylinder of claim 17, wherein the engine has a maximum speed less than 7000 rpm, and a cylinder displacement between 600 and 400 cubic centimeters per cylinder.

19. An intake port for an internal combustion engine having at least one cylinder, a piston mounted for reciprocating movement in the cylinder, said reciprocating piston in said cylinder defining a swept cylinder displacement, a cylinder head having one or more intake valves in fluid communication with said intake port, an intake valve seat for each of said one or more intake valves, each intake valve seat having an intake valve seat inner diameter for sealing contact with said valve, each of said valve seat inner diameters further having an inner valve seat cross section area, and an intake plenum,

said intake port for an internal combustion engine having an inlet end and an outlet end, said inlet end being in fluid communication with said plenum and said outlet end being in fluid communication with said intake valve for flow of intake air or another fluid from said plenum through said intake port into said cylinder,

wherein said intake port has a total outlet area, said total outlet area being equal to the sum of the inner valve seat cross section areas for the one or more intake valves in fluid communication with said intake port, and said intake port has an equivalent outlet diameter, said equivalent outlet diameter being equal to the square root of the quantity total outlet area times four divided by pi,

wherein said intake port includes a ram tuning pipe, a venturi having a throat and a venturi cross section area, said venturi cross section area being measured at said throat, a surge chamber, an outlet nozzle,

wherein the intake port has a ratio of venturi cross section area to total outlet area, said ratio of venturi cross section area to total outlet area being no more than 0.87,

wherein the intake port has a tuning length, said tuning length being the average distance between the throat and the one or more intake valve seat inner diameters,

wherein said surge chamber has a surge chamber inlet end and a surge chamber outlet end, said surge chamber inlet end being located 30 percent of the tuning length downstream of said throat, and said surge chamber outlet being located 20 percent of the tuning length upstream of said intake valve inner seat diameter, said surge chamber further having a volume within said intake port and between said surge chamber inlet end and said surge chamber outlet end,

wherein the surge chamber volume is greater than the product of total outlet area times 0.26 times the tuning length,

wherein said venturi has a venturi inlet end and a venturi outlet end, said venturi inlet end being located 5 percent of the tuning length upstream of said throat, and said venturi outlet being located 5 percent of the tuning length downstream of said throat, said venturi further having a venturi volume within said intake port and between said venturi inlet end and said venturi outlet end,

wherein the venturi volume is less than the product of total outlet area times 0.09 times the tuning length,

thereby providing an intake port with a high flow coefficient and dynamic tuning for a high volumetric efficiency.

20. The intake port for an internal combustion engine having at least one cylinder of claim 19, wherein the intake port has a ratio of venturi cross section area to total outlet area, said ratio of venturi cross section area to total outlet area being no more than 0.68,

wherein the surge chamber volume is greater than the product of total outlet area times 0.31 times the tuning length,

wherein the venturi volume is less than the product of total outlet area times 0.08 times the tuning length,

wherein the intake port has a ratio of surge chamber volume to venturi volume, said ratio of surge chamber volume to venturi volume being at least 5.3,

thereby providing a large surge chamber and a small venturi volume for a high port flow velocity and a high volumetric efficiency.

21. The intake port for an internal combustion engine having at least one cylinder of claim 20, wherein said intake port has a ratio of venturi cross section area to cylinder displacement, said ratio of venturi cross section area to cylinder displacement being no more than 0.0021 square millimeters of venturi cross section area per cubic millimeter of cylinder displacement,

thereby providing a small venturi nozzle cross-section area and high-speed inlet flow for high power output from the engine.